



The **CRUSHED STONE JOURNAL**

In This Issue

■
**Program for Cincinnati Convention
Nears Completion**

■
A Survey of Soil Stabilization


■
**The Use of Stone Screenings in Base
Construction**

■
**The National Crushed Stone Association
Safety Competition for 1936**

■
Should the Antitrust Laws be Revised?

■
What is Expected of Our Highways?

Sept.-Oct.-Nov. • 1937



Official Publication
NATIONAL CRUSHED STONE ASSOCIATION

Technical Publications
of the
National Crushed Stone Association, Inc.



BULLETIN No. 1

The Bulking of Sand and Its Effect on Concrete

BULLETIN No. 2

Low Cost Improvement of Earth Roads with Crushed Stone

BULLETIN No. 3

The Water-Ratio Specification for Concrete and Its Limitations

BULLETIN No. 4

"Retreading" Our Highways

BULLETIN No. 5

**Reprint of "Comparative Tests of Crushed Stone and Gravel Concrete in New Jersey"
with Discussion**

BULLETIN No. 6

The Bituminous Macadam Pavement

BULLETIN No. 7

Investigations in the Proportioning of Concrete for Highways

BULLETIN No. 8

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Industry (\$2.00 per copy)**

The Crushed Stone Journal

Official Publication of the NATIONAL CRUSHED STONE ASSOCIATION

J. R. BOYD, Editor

NATIONAL CRUSHED STONE ASSOCIATION



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Contents

	Page
Program for Cincinnati Convention Nears Completion - - - - -	3
A Survey of Soil Stabilization —W. J. Emmons - - - - -	6
The Use of Stone Screenings in Base Construction —A. T. Goldbeck - - - - -	8
The National Crushed Stone Association Safety Competition for 1936 —T. D. Lawrence and E. E. Getzin	10
Should the Antitrust Laws be Revised? —Robert H. Jackson - - - - -	13
What Is Expected of Our Highways? —Thos. H. MacDonald - - - - -	18



**RIVER-FRONT AND SKYLINE OF CINCINNATI, OHIO—
FROM KENTUCKY SHORE, OPPOSITE**

CINCINNATI has long been known as the Queen City, implying royal hospitality, among other gracious attributes. Easily accessible from South, East, North, West, Cincinnati and the smart and modern Netherland Plaza Hotel offer about everything any one could wish a convention city to have.

THE CRUSHED STONE JOURNAL

WASHINGTON, D. C.

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SEPT.-OCT.-NOV., 1937

Program for Cincinnati Convention Nears Completion

AS THE winter months approach, Cincinnati again becomes the center of interest for crushed stone producers. In that city on January 24, 25 and 26, 1938, members of the industry from all sections of the country will assemble for the Twenty-First Annual Convention of the National Crushed Stone Association. On this occasion opportunity will again be afforded crushed stone producers to exchange mutually helpful ideas, to engage collectively in the solving of common problems and to hear discussed by eminent authorities subjects of deep and far-reaching significance to the continued welfare and prosperity of the industry. In the friendly and sociable atmosphere of the annual meeting old friendships are renewed and new ones quickly made. There is no substitute for attendance at the annual meeting; those who have participated in these functions for many years—and their number is legion—will be the first to verify the accuracy of that observation.

The meeting in Cincinnati last January was enthusiastically held to have been the most instructive and enjoyable in many years, thereby imposing upon those charged with the responsibility of developing a program for the coming year a task of more than usual difficulty. This has constantly been kept in mind in preparing for the Twenty-First Annual Convention and we say confidently, and without fear of contradiction, that the program for Cincinnati next January will come up to every expectation.

Though it is too early to give full details, it is possible at this time broadly to outline some of the important subjects to be discussed. Following the plan so successfully used during the last two years, the Regional Vice-Presidents will be asked to prepare summary reports covering business conditions in their territories during 1937 and the outlook for 1938. These reports have become a valued addition to the

convention program and should be looked forward to with real interest.

Many of the foremost minds in the country are becoming more and more seriously concerned with the possible threat to the future of private enterprise. No man engaged in business, no matter in what industry he may obtain his livelihood, can overlook this trend. Donald D. Conn, Executive Vice-President, Transportation Association of America, has accepted our invitation to discuss this subject before the convention and his observations and suggestions should command our sympathetic attention. During the last two or three years there has been a definite swing in the crushed stone industry towards the use of Diesel electric power and it is, therefore, believed that a paper entitled, "Diesel Power in the Crushed Stone Industry," to be delivered by Lacey H. Morrison, Editor of "Diesel Power" and "Diesel Transportation," New York City, will prove of outstanding interest. Mr. Morrison, as his title indicates, is an outstanding authority in the Diesel power field. We are especially fortunate to have one so well informed on this subject to talk to us at Cincinnati.

The practical significance of today's methods for testing aggregate for construction is a subject concerning which we must keep constantly informed. Negotiations are now under way to have one of the outstanding authorities of the Federal Government bring us up to date in this regard.

Developments resulting from the silicosis agitation some months ago seem definitely in the direction of more restrictive state legislation, by no means confined to the question of silicosis, but being made to include the whole broad field of occupational disease. The laws recently passed by Illinois, Indiana, and New York foreshadow what may be expected in the field of state legislation. The increased financial bur-

den which may be placed upon business as the result of such legislation constitutes a real menace and we should be fully and comprehensively informed concerning this vital subject. Arrangements have been practically completed for the presentation of a discussion along these lines by one exceptionally well qualified in this field.

None will deny the present era is one of economic and social change. What is perhaps not so apparent, however, is the effect such changes may have upon the cost of doing business and failure to take into account such facts may well mean the difference between profit and loss. A. D. Berning, Resident Partner, Ernst and Ernst, has accepted our invitation to give us a discussion of this character and his observations should prove of distinct value to every producer in the industry. Today we hear much talk about the super-highways of the future, the possibility of separating truck traffic from passenger traffic, and many other factors which will have a vital influence upon the highway of tomorrow. No one in the United States is better informed in this field than Frank T. Sheets, President of the Portland Cement Association. Mr. Sheets has been invited to give us his views on this subject at Cincinnati and it is reasonably certain that he will accept.

Since our annual meeting last year the question of labor relations in the crushed stone industry has taken on added significance. An important feature of the Cincinnati program will be a "labor relations clinic," primarily for the purpose of permitting a full and free discussion of this important subject. In addition to the foregoing, many other topics of equal importance will be discussed at the convention—topics of such vital interest and real value to you in the daily conduct of your business that no member of the industry can afford to miss this meeting.

Advance applications for booth space for the Manufacturers' Division Exposition, to be held in conjunction with the convention, are running unusually heavy and give assurance that the exposition will substantially exceed the highly successful one of last year. The latest developments and improvements in machinery and equipment used in the production of crushed stone will be on display at Cincinnati. This feature of the meeting will prove especially appealing to superintendents and operating men as at no other time throughout the year are they afforded the opportunity of viewing such a comprehensive display assembled under one roof.

The annual convention and exposition is the real opportunity of the year for crushed stone producers

to obtain first-hand information as to the latest developments and trends vitally affecting their industry; to meet with fellow producers for the exchange of mutually helpful experiences and ideas; and to obtain, as it can be done on no other occasion, the inspiration and enthusiasm so necessary a requisite to the successful handling of the problems which must be faced during the year ahead.

All producers are most cordially and earnestly invited to participate in this annual foregathering of the industry, whether or not they are members of the National Crushed Stone Association. Make your plans now to be present.

Several States Seen in Danger of Federal Penalization for Misuse of Their Highway Funds

SEVERAL states appear to be in danger of being penalized financially by the federal government because they have used highway funds for non-highway purposes.

This is indicated by a study of figures for 1936, just released by the U. S. Bureau of Public Roads, which show extent of diversion of money from state highway funds.

New Jersey already has been penalized, under section 12 of the Hayden-Cartwright Act of 1934, for misuse of money raised by special fees and taxes levied on motorists. The Department of Agriculture has withdrawn \$250,000 of that state's share of 1937 federal road funds in accordance with the statute's penalty provision. At least two other states, it is understood, have been ordered by the Department to show why they should not be similarly penalized.

Analysis of the federal statistics by the National Highway Users Conference shows 36 states are guilty of misuse of highway funds last year, with the total amount diverted being \$169,344,000, an increase of \$22,202,000 over the previous year.

The Conference reports that state legislative activities this year reveal many efforts to ban diversion and thus to escape the federal penalty. Legislation leading to adoption of constitutional amendments outlawing diversion of highway funds has been adopted in Alabama, Indiana and Nevada. Statutes prohibiting diversion were enacted in Maine, North Dakota, South Dakota and Washington.

Consideration of anti-diversion proposals in this year's sessions of 23 states is reported by the Conference.—*Highway Highlights*.

Safety Awards Will be Made at Cincinnati Convention



EMPLOYEES OF THE COLUMBIA QUARRY COMPANY'S KRAUSE QUARRY NO. 1, WINNER OF THE N. C. S. A. SAFETY CONTEST FOR 1936.

AS IN the past, the awards to winners in the National Crushed Stone Association Safety Contest for 1936, recently announced by the United States Bureau of Mines, and published elsewhere in this issue, will be made at the time of the Cincinnati Convention next January. To the winner of the contest, the Krause No. 1 quarry, St. Clair County, Illinois, near Columbia, operated by the Columbia Quarry Co., will be presented "The Explosives Engineer" trophy. The contest was won by the Columbia Quarry Company's plant in competition with 53 other plants, 13 of which, in addition to the Krause No. 1 quarry, operated throughout the year 1936 with no lost-time accidents. When two or more plants have perfect records, first place is given the one operating the greatest number of man-hours—which placed the Krause No. 1 quarry at the top of the list with a total of 224,342 man-hours. Its near-

est competitor, the Marquette limestone quarry at Cape Girardeau, Missouri, operated by the Marquette Cement Mfg. Co., operated 126,621 man-hours. Honorable mention is accorded each contestant making a perfect record and, in addition to the presentation of the trophy at Cincinnati, each plant making a perfect record will receive a certificate of honorable mention. To all of the winners in the contest our sincere congratulations are extended, with special commendation to the Krause No. 1 quarry of the Columbia Quarry Co. which, in addition to winning the contest for 1936, completed on September 22, 1937, a five-year period with no lost-time accidents, with a total exposure during that period of 928,675 man-hours. We understand that the Krause No. 1 quarry will enthusiastically endeavor to maintain a perfect record during the second five-year span. In this undertaking we wish them the greatest success.



C. E. KLAUS
Supt. Krause Quarry No. 1
Columbia Quarry Co.



E. A. HEISE
Safety Engineer
Columbia Quarry Co.

A Survey of Soil Stabilization¹

By W. J. EMMONS

Associate Professor of Highway Engineering,
University of Michigan

INTELLIGENT design of a highway surface from a structural standpoint must recognize the primary importance of the foundation soil and must therefore be predicated upon subgrade characteristics.



Non-uniform subgrades or those subject to loss of bearing capacity due to the presence of water must be topped by thicker surfaces or surfaces capable of distributing the load over greater areas than is the case with subgrades of more favorable properties. Thus while it is possible to build a satisfactory surface over almost any type of subgrade, it is often far more economical so to correct the deficiencies of

the natural soil that it is capable of carrying a greater share of the traffic load under all conditions of use. It is this improvement of the inherent properties of the natural soil to which the term soil stabilization is applied.

As generally used, the term implies soil treatments involving mechanical manipulation and, usually, admixtures. However, it has been pointed out that a soil may be greatly improved by removing water which it contains and that, consequently, drained soils should be regarded as stabilized. If this is admitted it is but a slight extension of the argument to claim that a drainage installation, considerably removed from the highway which lowers the water table over a large area, or which intercepts seepage, also should be regarded as a stabilization process. Obviously this is stretching the definition too far, and it seems preferable to limit it strictly to manipulative treatments planned to insure a definite depth of soil of permanently improved properties.

¹ Presented at the Twenty-Third Annual Convention of the American Association of State Highway Officials, Boston, Massachusetts, September 27-30, 1937.

♦ Soil stabilization is an outstanding development in highway construction and is of major importance to the so-called "flexible type" of road in which stone is so largely used. In the present article Prof. Emons has briefly summarized the status of the science of stabilizing subgrades.

Recently the speaker was shown a section of road stated to have been built over a stabilized subgrade and was told that the earth was removed to a certain depth and replaced by coarse stone some 3 or 4 inches in diameter. No change was made in the soil properties. The road became more stable than the construction which preceded it because loads were distributed over greater areas of the underlying soil. Of course, this was base or subbase construction rather than stabilization, but the incident serves to illustrate the loose use of terms, of which there is far too much in our highway discussions.

The background of stabilization is the knowledge of those properties of soils which may usefully be employed and of those which require correction. Although tests have been developed which classify soils according to their physical characteristics and behavior, for this brief discussion they may be roughly grouped as gravel, sand, clay, and silt. Gravel and sand are referred to as granular soils. Soils predominately of clay are termed plastic soils. Silt is composed of grains finer than sand but coarser than clay.

Granular soils possess relatively high internal stability when confined, due to the ability of individual particles to transmit applied load to adjacent particles when tightly wedged together. Because of their large voids or limited areas of contact, the stability of granular soils is little affected by capillary water.

Soils classified as plastic may have ample ability to support loads when little moisture is present, but their extremely fine range of sizes with consequent small individual pore spaces render them highly susceptible to the concentration and retention of capillary water which forces the particles apart, destroying the cohesive bond upon which they depend for stability.

Silts are largely liabilities in the natural subgrade. They have little stability when dry and are extremely unstable when saturated. Capillary water rises through them rapidly. The cohesive force between silt particles is very low.

Granular soils are essentially aggregates; plastic soils are essentially binders. Each is useful, but must be used or treated with its inherent properties kept in mind.

Granular soils or those in which the coarse particles predominate are the simplest to stabilize since they are virtually unaffected by water. Deficiency of binder, causing displacement under load, is their usual fault. It is common practice to supply binder in the form of clay, with or without a moisture retentive salt, or an adhesive type of bituminous material. Relatively small amounts are necessary and they can be readily worked into the loose granular soil.

It is in the field of the finer soils, the plastic clays and silts, that the most intensive studies have been made and rather surprising results have been recorded. It is these soils which comprise the larger portion of our subgrades and their utilization constitutes a tremendous problem.

The most obvious solution in the case of plastic soils would be the combining of granular materials with them in proper proportions, thus providing mechanical stability and using the binding properties of the native soil. Sand-clay construction is an example of the application of this method. However, probably at least 70 per cent of the stabilized layer would have to be brought in and, as coarser materials are more often not easily available, the general adoption of the method is uneconomical.

It is necessary, therefore, either to preserve the favorable properties of the soil when dry by insulation of the subgrade volume from water or to so modify its capillary and seepage capacities, generally by the use of an admixture, that water is no longer drawn into the voids in sufficient quantities to produce instability.

The former expedient has been used, experimentally at least, by removing soil to the desired depth, placing a membrane of bituminous material or mixture, replacing and compacting the subgrade, and finally completing the envelope by a waterproof bituminous surface. With compactable soils of satisfactory stability under favorable conditions the method may have possibilities, but the preservation of the integrity of the lower treatment during construction operations presents a serious practical difficulty.

Most of the work with fine-grained soils is being done along the line of admixtures which leads directly into the relatively unexplored and highly complex field of physical chemistry.

The use of portland cement as an admixture is receiving widespread trials and appears to be quite successful. Its functions with relation to the soil are not fully understood. Distributed through a fine soil mass in percentages varying from 5 to 12 per cent, depending upon the fineness of the soil, there are not enough cement particles to coat the fine soil grains. Yet it does seem to contribute a considerable degree of cementing action, reduces or destroys the tendencies of the soil to swell and produces, when compacted, a mixture which is stable and resistant to freezing. Where economical amounts of cement produce mixtures of the desired characteristics, its use appears to be a satisfactory means of stabilization. The true nature of its action, chemical or physical, remains to be determined, and the methods of soil-cement mixture design and proportioning require investigation and refinement.

The prevalence of low-cost bituminous materials has encouraged their extensive study and experimental use as stabilization media. Liquid asphaltic products, emulsions, and tars have all been used. The object is to surround individual soil grains with a protective coating of the bitumen, thus preventing the operation of the normal capillary properties of the soil. The small amounts of bitumen supplied to coat the tremendous area presented by the soil particles results in the formation of extremely thin films and some investigators feel that cementing action may still be a function of the soil itself, exerted through the medium of intermolecular attraction.

In combining bituminous materials with fine grained soils many problems present themselves. The composition of the soil particles affects its relative affinity for water and for bitumen. Should the mineral particle be of such nature that its attraction for water is greater than for bitumen, it is difficult or impossible to coat it with a permanent protective film. This problem is being intensively studied, and various chemicals have been used experimentally to aid in completing the combination of bitumen and soils.

From a construction standpoint the mechanical difficulty of getting bitumen into the countless voids of a fine soil mass is apparent. This appears to have been solved by using the soil in a moist condition when the soil particles are separated by water films. During the mixing, compacting operations, and later, the water evaporates leaving the oil coating behind. Introduction of the oil has been by the common blade grader manipulation, the recently developed sub-piler and by traveling mixing plants.

Other investigations of the stabilization of fine textured soils have been along more purely chemical lines. Realizing that capillary water is the chief enemy of soil stability, the object is to so change the surface characteristics of soil particles that capillarity is destroyed or reduced to safe limits. Capillarity rise of water is a function of several factors and, with a given soil, all are unchangeable with the exception of that which expresses the ease with which a surface is coated with water. If this factor can be modified by permanently coating each particle with a water repellent material it is possible that capillary rise of water through soils can be controlled at will. Distinct progress has been made in this study, but thus far it is only a laboratory development which holds decidedly interesting possibilities.

Supplementing the theoretical aspects of stabilization which vary with the several processes is the physical manipulation which is universally essential for the greatest success. Thorough and uniform combination of admixtures with soils obviously is necessary. To an equal degree maximum possible compaction of the stabilized mixture is important in order to afford the greatest contact between particles for stability and to minimize the void space available for water entrance and retention.

Great strides have been made in the study of compaction processes in fill and earth dam construction, and these developments should be, and generally are, being applied to stabilized soil placement. Optimum moisture content, at which soils can be compacted to the greatest density, is becoming a familiar term on soil improvement projects. The necessary tests to determine the relationship between water content and compacted soil density are quickly made in the laboratory. A simple penetration test applied at frequent intervals on the job as compaction progresses is correlated with the laboratory data and enables the inspector to determine when ultimate consolidation is attained. Control of compaction is as important as any other detail of the stabilization process.

The highway engineer has at his disposal a considerable number of stabilization methods. Most of them are in the experimental stage but several have reached the field and are giving successful results. It should be emphasized strongly that it is necessary to make thorough investigations before deciding upon the type and degree of treatment which a soil is to receive. The reaction of the soil and the added constituents, the possibility of securing stabilization of the desired quality, the consolidation characteristics of the mixture, all must be determined in the labora-

tory. There, also, must be prepared the applied data which the construction procedure must follow. Without question, this is one phase of improvement where the intimate cooperation of the laboratory and construction organizations is indispensable.

There has been a tendency, as is common with newly developed processes, to expect more service of stabilization than it is likely to provide. In general, the stabilized soil mixtures produced thus far are not suitable for extended use as wearing surfaces. They are designed for resistance to load deformation under all conditions of service and for a certain degree of resistance to weathering, but not to withstand the abrasive wear of traffic. Base and surface courses have long been built with the dual purpose of carrying traffic and compensating for unreliable subgrades, but in attempting to take advantage of the apparent economy of the stabilized subgrade, the swing should not be to the opposite extreme. Intelligent design must recognize the stabilized soil layer for just what it is, a foundation, and still provide a suitable wear resistant surface over it.

Surveyed from all angles the interest, research, and accomplishments in the improvement of soils constitute the most important development in the highway engineering field which has occurred in many years. Properly regarded and applied, soil stabilization should promote economy of construction and maintenance, remove many of the uncertainties of highway design, and bring us a step closer to the millennium, that far distant day when we can build a "permanent road."

The Use of Stone Screenings in Base Construction

By A. T. GOLDBECK

Engineering Director
National Crushed Stone Association

IN THE preceding article entitled, "A Survey of Soil Stabilization," Professor Emmons has very properly pointed out that variations in interpretation of the term "soil stabilization" are often encountered and, strictly speaking, that term should be confined to alterations in subgrade soils by the use of admixtures which will bring about a favorable change in their physical characteristics so that they will be better enabled to carry loads at all seasons of the year. These admixtures take the form of coarsely granular materials which act in a mechanical manner to increase load capacity, salts such as calcium

chloride or sodium chloride, bituminous materials and also portland cement.

A granular soil alone may have high stability when it is well compacted, for it holds very little capillary water, has practically no volume change and the tightly wedged granular particles are capable of transmitting load with very little motion. It is desirable for the best results that there be no more fine particles than are necessary to fill the voids, for the coarse particles should not be separated by an easily deformable film or layer of fine particles. This condition would bring about instability were the soil to become saturated. It is for this reason that when granular admixtures are added to finely divided, unstable soils for the purpose of stabilizing them, the resulting mixture may have to contain a much higher percentage of the granular stabilizing material than of the original soil. On the other hand, comparatively small percentages of salts, bituminous materials or portland cement are used for stabilizing finely divided unstable soils and the question of relative economy should be considered in connection with the various stabilization methods.

Stone screenings need not be used as an admixture to soils to create a stable layer, for stone screenings alone have remarkable load-carrying capacity and stability under changing moisture conditions. When mixed with the stabilizing agents now advocated, such as common salt, calcium chloride, emulsions, other bituminous materials or portland cement, their stability may be still further improved. Researches have been and are still being conducted in the National Crushed Stone Association laboratory looking into the effect of gradation and of various admixtures and in some cases the ability of screenings to carry loads on a saturated clay subgrade is outstanding.

A stabilized layer of stone screenings will form an excellent base course for a bituminous wearing surface. This wearing surface may be a mere bituminous surface treatment or one of the thicker bituminous mixtures commonly employed. Such a screenings layer should form an excellent base for shoulder maintenance, or a sub-base for higher road types such as concrete and various bituminous types. A layer of screenings is also extremely useful as a blanket layer under a crushed stone base to prevent the upward intrusion of clay into the voids of the stone. Sidewalks such as now actively built in New England in connection with highways also furnish a very suitable use for screenings.

Highway Research Board Meets in Washington, November 30-December 3, 1937

WE DESIRE to direct the attention of crushed stone producers to the Annual Meeting of the Highway Research Board to take place in Washington on November 30 and December 1, 2 and 3, 1937, at the building of the National Academy of Sciences and National Research Council, 2101 Constitution Avenue. This Seventeenth Annual Meeting of the Board should prove of decided interest and value to those members of our industry who may find it possible to be in Washington at that time. The following list of topics is scheduled for discussion:

FINANCE AND ECONOMICS: Financial Administration with Special Reference to Local Roads and Streets; Uniform Highway Accounting; Vehicle Operating Costs; Efficiency-Tractive Resistance Ratio; Economic Life of Pavements; Prevailing Speeds as a Measure of Road Capacity; Error in Short Time Traffic Counts.

HIGHWAY DESIGN: Relations Between Curvature and Speed; Design of Flexible Pipe Culverts; Flexible Type Surfaces; Safety and Speeds as Affecting Highway Design; Stresses in Concrete Pavements; Apparatus for Friction Tests; Use of High Elastic Limit Steel as Concrete Reinforcement; Distribution of Pressure on Contact Areas of Tires; Needed Research for Precise Determination of Sight Distance; Highway Design Research as Related to Safety.

ROADSIDE DEVELOPMENT: Report of Joint Committee of American Association of State Highway Officials and Highway Research Board; Highway Cross Sections; Erosion, Drainage and Wayside Areas from Standpoints of Design, Maintenance and Roadside Development; Relation of Highway Design to Landscape Objectives; Slope Erosion; Education and Public Relations; Zoning; Highway Types and Roadside Areas; Plant Materials; Costs.

MATERIALS AND CONSTRUCTION: Durability Tests of Portland Cements; Fillers and Cushion Courses for Brick and Block Pavements; Construction Equipment for Stabilized Roads; Measurement of Heat of Hydration of Cement; Vibration of Pavement Concrete—France, Wisconsin, Kansas, Illinois; Service Behavior Compared with Los Angeles Abrasion Tests; Freezing and Thawing Tests of Aggregates; Properties of Asphalts; A Study of Translucent Asphaltic Films.

MAINTENANCE: Distortion of Concrete Pavements; Maintenance Costs.

TRAFFIC AND SAFETY: Seeing on the Highway; Accident Reporting and Recording; Traffic Regulations; Accident Prone and Accident Free Drivers; Tests of Drivers; The Highway Safety Problem; Traffic Regulation on One-Way Streets; Perception and Visibility of License Plates.

SOILS INVESTIGATIONS AND STABILIZED ROADS: Bridge Pier Foundations; Abutment Foundations and Lateral Thrusts; Cofferdams; Foundations for Embankments; Embankments; Stabilized Roads; Cement Stabilization; Sand-Asphalt Stabilization; German Motor Roads.

The National Crushed Stone Association Safety Competition for 1936

By **T. D. LAWRENCE** and
E. E. GETZIN

Under supervision of **W. W. Adams**, Employment
Statistics Section, Mineral Production and Eco-
nomics Division, United States Bureau of Mines

THE National Crushed Stone Association Safety Competition covering the calendar year 1936 was the eleventh yearly safety contest conducted by the United States Bureau of Mines in cooperation with the National Crushed Stone Association. There were 54 plants, consisting of four underground mines and fifty open-quarries located in 17 States, that participated in the contest, and of these, fourteen worked a total of 1,135,633 man-hours during the year without an accident causing loss of time to any of the employees. The records reveal that 6,733,950 man-hours of work was accomplished during the year, which was 55 per cent more than that represented by the enrollment in the previous year's contest.

The Explosives Engineer magazine provided a trophy for presentation to the company that established the best safety record, that is, the mine or quarry whose record showed the fewest days lost from accidents per thousand man-hours of exposure. When two or more plants are operated without an accident, the company working the largest number of man-hours is awarded the trophy, each of the other plants receiving a certificate of honorable mention for its efforts in advancing safety and eliminating accidents.

The trophy for 1936 was won by the Krause No. 1 quarry, St. Clair County, Illinois, near Columbia, Monroe County, Illinois, operated by the Columbia Quarry Company. During 1936 the quarry worked 224,342 man-hours without a lost-time accident. This plant has established an accident-free record of 726,998 man-hours during the past four years, 1933 to 1936 inclusive; and during that period the plant was awarded the trophy in 1935 and honorable mention in 1933 and 1934.

During the 1936 contest, in addition to the trophy winner, 11 quarries and two underground mines operated with perfect accident records; and each was therefore awarded a certificate of honorable mention. The plants winning the certificates for accident-free records were:

1.—Marquette limestone quarry, Cape Girardeau, Cape Girardeau County, Missouri, operated by

the Marquette Cement Manufacturing Company. The quarry worked 126,621 man-hours in 1936.

- 2.—Holston limestone quarry, Mascot, Knox County, Tennessee, operated by the American Zinc Company of Tennessee. The quarry worked 125,836 man-hours in 1936.
- 3.—Columbia No. 3 limestone mine, Valmeyer, Monroe County, Illinois, operated by the Columbia Quarry Company. The mine worked 124,028 man-hours in 1936.
- 4.—Berkeley Nos. 5 and 6 limestone quarry, Martinsburg, Berkeley County, West Virginia, operated by the North American Cement Corporation. The quarry worked 109,091 man-hours in 1936.
- 5.—Middlefield No. 1 trap rock quarry, New Haven County, Conn., near Middlefield, Middlesex County, Conn., operated by the New Haven Trap Rock Company. The quarry worked 79,432 man-hours in 1936.
- 6.—Le Roy limestone quarry, Le Roy, Genesee County, New York, operated by the General Crushed Stone Company. The quarry worked 78,657 man-hours in 1936.
- 7.—Jordanville limestone quarry, Jordanville, Herkimer County, New York, operated by the General Crushed Stone Company. The quarry worked 67,101 man-hours in 1936.
- 8.—Akron limestone quarry, Akron, Erie County, New York, operated by the General Crushed Stone Company. The quarry worked 57,390 man-hours in 1936.
- 9.—Catskill limestone quarry, Catskill, Greene County, New York, operated by the North American Cement Corporation. The quarry worked 38,574 man-hours in 1936.
- 10.—Cheshire No. 6 trap rock quarry, Cheshire, New Haven County, Conn., operated by the New Haven Trap Rock Company. The quarry worked 33,241 man-hours in 1936.
- 11.—Gasport limestone quarry, Gasport, Niagara County, New York, operated by the Wickwire Spencer Steel Company. The quarry worked 31,666 man-hours in 1936.

- 12.—Oglesby limestone mine, Oglesby, La Salle County, Illinois, operated by the Marquette Cement Manufacturing Company. The mine worked 24,067 man-hours in 1936.
- 13.—Howes Cave limestone quarry, Howes Cave, Schoharie County, New York, operated by the North American Cement Corporation. The quarry worked 15,587 man-hours in 1936.

The accident-severity rates ranged from zero to 193.0 days lost per thousand man-hours; and the accident-frequency rates ranged from zero to 226.9 accidents per million man-hours of exposure, and the length of time the various plants were in operation ranged from 14,906 man-hours to 492,730 man-hours. The average period of disability for temporary injuries at quarries was 25 days, and for all injuries,

TABLE 1.

RELATIVE STANDING OF PLANTS IN THE 1936 NATIONAL CRUSHED STONE ASSOCIATION SAFETY COMPETITION, BASED UPON THE ACCIDENT-SEVERITY RATES OF THE PLANTS (QUARRY GROUP)¹.

Code No.	Group No.	Hours worked	Number of accidents					Number of days lost					Frequency rate	Severity rate
			Fatal	P.T.	P.P.	Temp.	Total	Fatal	P.T.	P.P.	Temp.	Total		
1	1	224,342	..	..	..	..	..	..	..	..	..	..	0.000	0.000
2	2	126,621	..	..	..	..	..	..	..	..	..	..	.000	.000
3	3	125,836	..	..	..	..	..	..	..	..	..	..	.000	.000
5	4	109,091	..	..	..	..	..	..	..	..	..	..	.000	.000
6	5	79,432	..	..	..	..	..	..	..	..	..	..	.000	.000
7	6	78,657	..	..	..	..	..	..	..	..	..	..	.000	.000
8	7	67,101	..	..	..	..	..	..	..	..	..	..	.000	.000
9	8	57,390	..	..	..	..	..	..	..	..	..	..	.000	.000
10	9	38,574	..	..	..	..	..	..	..	..	..	..	.000	.000
11	10	33,241	..	..	..	..	..	..	..	..	..	..	.000	.000
12	11	31,666	..	..	..	..	..	..	..	..	..	..	.000	.000
14	12	15,587	..	..	..	..	..	..	..	..	..	..	.000	.000
15	13	55,530	..	..	..	1	1	..	..	..	2	2	18.073	.036
16	14	65,114	..	..	..	1	1	..	..	..	3	3	15.358	.046
17	15	222,467	..	..	..	3	3	..	..	..	43	43	13.485	.193
18	16	218,011	..	..	..	4	4	..	..	..	47	47	18.348	.216
19	17	173,577	..	..	..	7	7	..	..	..	50	50	40.328	.288
20	18	72,844	..	..	..	3	3	..	..	..	21	21	41.184	.288
21	19	492,730	..	..	..	3	3	..	..	..	207	207	6.089	.420
22	20	49,901	..	..	..	2	2	..	..	..	31	31	40.079	.621
23	21	57,397	..	..	..	2	2	..	..	..	36	36	34.845	.627
25	22	183,832	..	..	..	10	10	..	..	..	133	133	54.397	.723
26	23	99,295	..	..	..	2	2	..	..	..	73	73	20.142	.735
27	24	73,405	..	..	..	3	3	..	..	..	55	55	40.869	.749
28	25	125,132	..	..	..	4	4	..	..	..	106	106	31.966	.847
29	26	112,310	..	..	..	3	3	..	..	..	105	105	26.712	.935
30	27	181,386	..	..	..	2	2	..	..	..	180	180	11.026	.992
31	28	251,960	..	..	1	9	10	..	..	75	184	259	39.689	1.028
32	29	92,533	..	..	..	21	21	..	..	..	110	110	226.946	1.189
33	30	106,429	..	..	..	2	2	..	..	..	127	127	18.792	1.193
34	31	90,442	..	..	..	6	6	..	..	..	114	114	66.341	1.260
35	32	100,800	..	..	..	1	1	..	..	..	131	131	9.921	1.300
36	33	223,455	..	..	1	2	3	..	..	300	22	322	13.426	1.441
37	34	244,719	..	..	..	22	22	..	..	..	368	368	89.899	1.504
38	35	14,906	..	..	..	1	1	..	..	..	24	24	67.087	1.610
39	36	63,744	..	..	..	4	4	..	..	..	107	107	62.751	1.679
40	37	20,329	..	..	..	2	2	..	..	..	37	37	98.382	1.820
41	38	144,616	..	..	1	..	1	..	..	300	..	300	6.915	2.074
42	39	191,630	..	..	2	6	8	..	..	360	62	422	41.747	2.202
43	40	162,325	..	..	1	7	8	..	..	300	96	396	49.284	2.440
44	41	76,630	..	..	..	2	2	..	..	..	187	187	26.099	2.440
45	42	145,687	..	..	..	10	10	..	..	..	393	393	68.640	2.698
46	43	286,648	..	..	3	13	16	..	..	608	358	966	55.818	3.370
47	44	107,980	..	..	..	5	5	..	..	..	716	716	46.305	6.631
48	45	81,839	..	..	1	1	2	..	..	1,800	31	1,831	24.438	22.373
49	46	205,140	1	..	..	5	6	6,000	..	..	58	6,058	29.248	29.531
50	47	312,299	1	..	3	8	12	6,000	..	3,750	333	10,083	38.425	32.286
51	48	177,672	1	..	1	5	7	6,000	..	675	40	6,715	39.398	37.794
53	49	95,884	1	..	..	..	1	6,000	..	..	..	6,000	10.429	62.576
54	50	31,067	1	..	..	..	1	6,000	..	..	..	6,000	32.168	193.007
Totals and rates, 1936		6,399,203	5	0	14	182	201	30,000	0	8,168	4,590	42,758	31.410	6.682
Totals and rates, 1935		4,166,306	2	1	8	77	88	12,000	6,000	9,900	3,015	30,915	21.122	7.420

¹ As the accident reports from mining companies are considered confidential by the Bureau of Mines, the identities of the plants to which this table relates are not revealed. Frequency rate indicates number of fatal, permanent, and other lost-time accidents per million man-hours of exposure; severity rate indicates number of days lost from accidents per thousand man-hours.

Note: P.T. means permanent total disability; P.P. means permanent partial disability; and Temp. means temporary disability.

including charges for deaths and permanent injuries, the average was 213 days.

Tables 1 and 2 show the relative standing of the open-quarries and underground mines, respectively, arranged according to the accident-severity rates of the various plants. Table 3 represents comparative

statistics for all participating quarries and mines during a period of 12 years. The contest was inaugurated in 1926 and the first year in the table (1925) shows the record of the member companies the year before the contest began.

TABLE 2.

RELATIVE STANDING OF PLANTS IN THE 1936 NATIONAL CRUSHED STONE ASSOCIATION SAFETY COMPETITION, BASED UPON THE ACCIDENT-SEVERITY RATES OF THE PLANTS (UNDERGROUND-MINE GROUP)¹

Code No.	Group No.	Hours worked	Number of accidents					Number of days lost					Frequency rate	Severity rate
			Fatal	P.T.	P.P.	Temp.	Total	Fatal	P.T.	P.P.	Temp.	Total		
4	1	124,028	..	..	..	...	...	.....	.....	.....	.....	.....	0.000	0.000
13	2	24,067	..	..	..	...	...	.....	.....	.....	.....	.....	.000	.000
24	3	78,497	..	..	..	2	2	.....	.....	.....	55	55	25.479	.701
52	4	108,155	1	..	..	5	6	6,000	.....	.....	62	6,062	55.476	56.049
Totals and averages, 1936		334,747	1	0	0	7	8	6,000	0	0	117	6,117	23.899	18.274
Totals and averages, 1935		175,994	0	0	0	3	3	0	0	0	249	249	17.046	1.415

¹ See footnotes for table 1.

TABLE 3.

YEARLY SUMMARY—NATIONAL CRUSHED STONE ASSOCIATION SAFETY CONTEST, 1926-1936

Year	Plants	Hours worked	Number of accidents ²					Number of days lost ²					Frequency rate ¹	Severity rate ¹	
			Fatal	P.T.	P.P.	Temp.	Total	Fatal	P.T.	P.P.	Temp.	Total			
OPEN QUARRIES															
1925 ³	38	4,927,402	4	..	3	292	299	24,000	.....	3,600	5,286	32,886	60.681	6.674
1926 ³	40	5,298,983	3	..	6	207	216	18,000	.....	9,000	4,239	31,239	40.763	5.895
1927	48	7,876,791	9	..	2	458	469	54,000	.....	2,100	7,186	63,286	59.542	8.034
1928	53	7,509,098	8	..	4	322	334	48,000	.....	8,700	5,493	62,193	44.479	8.282
1929	53	7,970,325	4	..	5	286	295	24,000	.....	5,760	5,533	35,293	37.012	4.428
1930	68	8,013,415	6	..	9	227	242	36,000	.....	7,250	3,671	46,921	30.199	5.855
1931	58	5,085,857	4	..	13	198	215	24,000	.....	18,660	3,540	46,200	42.274	9.084
1932	40	2,661,850	1	..	4	75	80	6,000	.....	6,750	2,481	15,231	30.054	5.722
1933	40	2,704,871	1	..	1	67	69	6,000	.....	48	2,393	8,941	25.510	3.306
1934	46	3,288,257	1	..	2	106	109	6,000	.....	2,850	1,873	10,723	33.148	3.261
1935	46	4,166,306	2	1	8	77	88	12,000	6,000	9,900	3,015	30,915	21.122	7.420	
1936	50	6,399,203	5	..	14	182	201	30,000	.....	8,168	4,590	42,758	31.410	6.682
Total 12 years	..	65,902,358	48	1	71	2,497	2,617	288,000	6,000	82,786	49,800	426,586	39.710	6.473	
UNDERGROUND MINES															
1925 ³	3	400,672	..	..	..	29	29	.....	.....	.....	228	228	72.378	0.569
1926	3	517,926	..	..	..	34	34	.....	.....	.....	533	533	65.646	1.029
1927	2	318,449	1	..	1	14	16	6,000	.....	300	68	6,368	50.244	19.997
1928	5	542,193	1	..	1	68	70	6,000	.....	300	888	7,188	129.105	13.257
1929	4	665,520	1	..	1	30	32	6,000	.....	300	617	6,917	48.083	10.393
1930	6	595,367	1	..	1	15	17	6,000	.....	225	468	6,693	28.554	11.242
1931	3	345,105	..	..	..	4	4	.....	.....	.....	147	147	11.591	.426
1932	2	158,450	..	..	..	6	6	.....	.....	.....	165	165	37.867	1.041
1933	3	229,381	..	..	..	11	11	.....	.....	.....	349	349	47.955	1.521
1934	4	248,146	..	..	..	13	13	.....	.....	.....	287	287	52.389	1.157
1935	2	175,994	..	..	..	3	3	.....	.....	.....	249	249	17.046	1.415
1936	4	334,747	1	..	..	7	8	6,000	.....	.....	117	6,117	23.899	18.274
Total 12 years	..	4,531,950	5	0	4	234	243	30,000	0	1,125	4,116	35,241	53.619	7.776	

¹ Frequency rate indicates the number of fatal, permanent, and other lost-time accidents per million man-hours of exposure; severity rate indicates the number of days lost from accidents per thousand man-hours.

² P.T., permanent total disability; P.P., permanent partial disability; Temp., temporary disability.

³ The National Crushed Stone Association safety contest began in 1926; figures for 1925 for company members are given for comparison.

Should the Antitrust Laws be Revised?¹

By ROBERT H. JACKSON

Assistant Attorney General of the United States

FOR forty years the United States has had a statute that appears to condemn every combination which restrains trade. Its general language might include almost any combination, trade association or industry. But we have court decisions which make possible a plausible legal defense of almost any combination in restraint of trade. What business conduct the resulting law will really reach, has become our major governmental mystery.

As a result of this confusion, we are faced with the following inescapable facts:

1. The Department of Justice has no satisfactory standards by which cases can be selected for prosecution or by which the success of any given prosecution may be predicted with assurance.
2. Business enterprise has no safe standards by which it may determine in advance the validity of concerted action, even when the principal purpose is to eliminate waste, or reduce costs of production or distribution.
3. The administrative arm of the government is unable to give commitments as to any combination, because the confusion of precedents and policy is such that a position taken in one case may prove an embarrassment in others.

The sum of these three facts is that there is *no stated or intelligible policy which differentiates pursuit of industrial efficiency from industrial empire building.*

Every antitrust problem is economic as well as legal. Economic questions are not well investigated or settled in an adversary combat, conducted under technical rules and evidentiary limitations. A bitterly contested case drags a delirious course from court to court, and is seldom completed within the administration that begins it. The appropriations for enforcement will not sustain more than a half dozen contested suits, and is utterly inadequate to the task of policing our national economy.

I have no interest in "trust busting" for the sheer

♦ The attitude of the present Administration on this important question is clearly and comprehensively set forth in the following article by Mr. Jackson. His views should prove of unusual interest at this time.

joy of "trust busting," or in legal assaults on combinations which have economic necessity on their side. We should not spend great sums to obtain decrees which are economically unenforceable and, when carried out in form, are often only lessons in futility. Antitrust suits provide spectacular legal battles and "famous victories." But this exercise for legal theoreticians often fails to produce any discernible economic effect.

I do not belittle the importance of present or past efforts to enforce the law through antitrust suits. Though they have failed to break up price controlling organizations, or to check the continuing concentration of wealth and of industrial control, they have doubtless saved us many evils that would have accomplished completely unsupervised organizations. They have furnished, although obscurely, standards of conduct and business practices which have improved business ethics during the process of centralization of American industry. They have saved us from the cartel system of Europe.

I am interested in the establishment of a consistent national policy of monopoly control, intelligible both to those expected to comply with it and those expected to enforce it. Destruction of monopoly has been a high sounding generality advocated by both political parties, in nearly every campaign—but never with a too troublesome definiteness. "To be grandly vague," writes Herman Finer, "is the shortest route to power; for a meaningless noise is that which divides us least." For forty years administrations have alternated between a policy of being aggressively vague and passively vague, until an attempt to reduce business practice and control to definite and intelligible codes was made under the National Industrial Recovery Act. Apart from any other value or defect of that plan, the brief experience with cooperative instead of competitive effort in industry should contribute richly in standards by which to weigh all future plans for social control of industry.

¹ Presented before the Trade and Commerce Bar Association and Trade Association Executives of New York at the Hotel Astor, New York City, September 17, 1937.

Antitrust Policy and Its Alternative

The basic philosophy and object of the antitrust laws and the probable alternative if they fail, are too little understood.

The antitrust laws represent an effort to avoid detailed government regulation of business by keeping competition in control of prices. It was hoped to save government from the conflicts and accumulation of grievances which continuous price control would produce, and let it confine its responsibility to seeing that a true competitive economy functions.

But it is a mistake to believe that they represent a philosophy of unconcern or indifference about our economic life. They assert, on the contrary, a definite economic plan, a sovereignty of public over private interest in business, and an affirmative control over our economic life to provide conditions under which competition will function effectively.

To this end, though we know competition to be ruthless and at times a wasteful regulator, each competitor is protected and fostered, even if he be a "chiseler," an underseller, and a hair shirt to his industry.

Also, since there can be no effective competition except between rivals with some equality of strength and resource, and since many sources of supply are best assurance of competition, the law aims to prevent concentration of wealth, and centralization of industrial, financial, or trade control, as well as complete monopoly.

This competitive system, between business groups, free and uncentralized, reduces the responsibility of the government to keeping the channels of competition unobstructed. This is the lowest degree of government control that business can expect.

The question we face today is whether we can keep that kind of economy, or whether we will be forced by its breakdown to other and more drastic regulation.

American business must make up its mind whether it favors the regulation by competition contemplated by our antitrust laws, or the only probable alternative—government control. Every step to weaken antitrust laws or to suspend them in any field, or to permit price fixing, is a certain, even if unknowing, step to government control.

Many leaders of conservative thought recognize that American business is faced with this alternative.

In April, commenting on the fact that the Aluminum Company suit not only puts the company on

trial for monopoly, but also puts the existing antitrust laws on trial, Mr. Walter Lippman said:

"The restoration of competition is the only possible alternative to socialism, and it would be useless, as well as hypocritical, for any one to object to the collectivism of the New Deal and yet to cry out that an unmistakable economic monopoly should be tolerated by the law. * * *

"Moreover, if private big business collectivism is to be tolerated in the basic manufacturing industries, then all other producers, farmers, secondary manufacturers, and workers in other industries are compelled to organize socialistically to protect themselves against such monopolies."

Let us now turn to certain symptoms of the failure or inadequacy of the present antitrust laws.

Decline of Competition

Economists recognize a decline of competition and express anxiety as to its meaning.

The statistics show the disappearance of large numbers of industrial units. An era of bankruptcy has followed an era of merger and consolidation and only a relatively small number of industrial units and sources of supply have survived. Competition among them is often moderated by financial controls, interlocking directorate, or by patent controls, basing point practices, or price leadership, or dominance in an industry. The probability of new units is greatly reduced by the constantly increasing investment necessary to secure the benefits of mass production, and by the high costs of cultivating a national market.

The sharpest illustration of lessened competition is the experience of the government as a buyer. It should be the last to feel a decline of competition. Not only do laws protect the existence of competition among sellers, but the government is also required by law to purchase only on the basis of competitive bids. A rather ponderous machinery is set up for the handling of sealed offers—an official call for bids, great secrecy of the sealed envelopes placed in a strong box in a department safe as they are received, a tense moment on the announced day when the bids are made public—and then a fizzle. I can bring the matter home to you best by specific examples from among many available.

The Denver office of the Bureau of Reclamation opened 17 bids for reinforcement bars, 14 of which were identical to the last penny, namely, \$1,144.16. The United States Engineers at Los Angeles opened 12 bids for reinforcement bars and 11 of them were

identical—\$194,051.89. The purchasing agent for the Fort Peck Dam opened 10 bids on reinforcement bars and each one of the 10 was \$253,633.80. In February, 1936, 16 companies each bid \$3,483.50 on a steel sheet order and in June, 15 companies each bid exactly the same figure again for a similar order. Steel plates bids present a similar record. In steel pipe the price situation appeared when 59 bids were opened by the Navy Department and each of the 59 companies bid \$16,001.83.

In government purchase of explosives about 425 bids were opened during 1935 and the first half of 1936 and the great majority were identical. Bids on cement follow the same pattern. In one instance 40 companies each bid exactly \$7,148.60. On another contract 43 bids were identical. The same situation has occurred with products of nearly all metal, paper, rubber, meat, wood, batteries, explosives, cement, machinery, office supplies, chemical and medical supplies, and all plumbing supplies.

I am not now passing judgment as to whether these bids are the result of a punishable conspiracy. But they certainly were not the result of identical costs of manufacture, nor of independent estimates. They are the product of artificial marketing machinery. Our antitrust laws are often interpreted to prohibit methods rather than results. What may be illegal if accomplished in one way, is held to be legal, if accomplished in another.

No matter whether the private business controls and arrangements which produce identical bidding be what the courts have heretofore called legal, or illegal, the effect is to compel purchasers to pay a price based on calculation, not on competition. Whatever the effect of this on private buyers, it completely destroys the mechanism set up by Federal, State and municipal governments to keep favoritism and corruption out of public buying. And it provides dramatic evidence that price competition in many industries is under mathematical control to the fraction of a cent.

Controlled Prices and Price Disparities

This ability of some industries to control or peg their prices, while others fluctuate, results in a disastrous price disparity.

During the depression prices of some commodities remained relatively stationary and rigid, while certain others were flexible and moved up and down with the ebb and flow of business activity. For example, prices received by the farmer during the de-

pression showed the greatest sensitivity and fell, as a whole, about 57% and grains about 64%, while agricultural implements declined less than 17% as a maximum and for most of the years the decline was only 5% or 6%, using the 1926 price level as 100% in each instance.

These figures may give the impression that we merely have a contrast between the prices of agricultural products and of manufacturers. However, highly competitive textiles such as cotton goods, compared with the average for 1926, went off 50%, knit goods 53%, silk and rayons about 75%, while less competitive metal and metal products reached 23% as a maximum and the decline for most of the period was less than 15%.

The conviction grows that the difference between the rigid price in some lines and the sensitive price in others is largely influenced by the private economic planning done by those who object most vigorously to the Nation's engaging in public economic planning.

Price Control Does Not Stabilize Production or Employment

If rigid prices meant stability of employment in the industry, we would find price control more tolerable. But generally the more rigid and inflexible the price of a product during the depression the more calamitous was the decline in its labor's pay roll. In some industries pay rolls almost vanished, although prices of the product were little affected. According to the Bureau of Labor Statistics pay rolls for the iron and steel industries declined about 75% while the wholesale price of ingots declined only 16%. The depression prices of cast iron pipe declined 7% and pay rolls declined 74%. While agricultural implements declined 14% in price, that industry's pay roll took the prize decline of 83%. Virgin aluminum went down 21% in price and pay rolls of aluminum manufacturers declined about 70%. Cement declined 13% and its pay rolls 72%.

There seems to be something the matter with conditions which yield these percentages. This is confirmed by reference to the price and pay roll percentages for more competitive industries. Prices on woolen and worsted goods declined 34% and the pay rolls about 51%. Cotton goods showed a decline of 43% and less than 51% in pay rolls. Knit goods declined 42% in price and 42% in pay roll. Leather showed a decline of 44% in price and 42% in pay roll.

Of course there are factors influential in producing these percentages, other than the factor of monopoly, or price control. But the correspondence between rigid prices and low pay rolls is so general as to surpass the probabilities of coincidence. The kind of "industrial stability" which means the ability to avoid price concessions, does not promote, even if it does not injure, stability of employment or wage levels.

Economic Concentration

The concentration of ownership and control of industry is fatal to the operation of competitive economy. Concentration destroys the sources and possibilities of competition, and the antitrust statutes attempt to check it, but the courts, blind to this purpose, have said "size is no offense."

Concentration of corporate ownership of wealth, chiefly means of production, has proceeded to a surprising degree. In 1932, according to the statistics of the Bureau of Internal Revenue, 53% of all corporate owned assets in this country was held by 618 corporations, which constitute only .2 of 1% of the number of corporations reporting. Five per cent of the corporations owned 85% of all the corporate owned wealth in 1932. More than 50% of all the net income enjoyed by corporations in 1932 went to 232 corporations, while of the country's manufacturing corporations 1.2% of the total number accounted for 63% of the aggregate net profits. In 1934 the only group of corporations to earn an aggregate net profit was the group whose assets exceeded \$50,000,000. Thus, the process of concentration was continuing.

There was likewise a high degree of concentration in the ownership of these corporations. 1929 was a banner year for stock ownership and in that year the 3.28% of the population who filed individual income tax returns accounted for the receipt of more than 83% of all dividends paid to individuals. And 78% of those dividends reported were received by .3 of 1% of our population.

In 1933 the Bureau of Internal Revenue statistics show that there were only 1,747,740 taxable individual incomes in the United States and nearly 1/3 of all the property reported as passing by death was found in less than 4% of the estates. You are all familiar with the Brookings Institution's studies in 1929 which report that about 6,000,000 families or 21% of all families had family incomes of less than \$1,000 annually, and that 36,000 families in the high income brackets received as much of our

national income in that year as 11,000,000 families with the lowest incomes.

Even these statistics do not properly measure the degree of concentration of control of industry for by holding companies and inter-locking directorates many corporations may be under a single control and there is no discernible limit to the centralizing tendency.

The Canadian Royal Commission on Price Spreads recently made the following observations:

"At first sight, indeed, it appeared that the separate and distinct problems which emerged in the evidence called for separate treatment and almost separate reports. On closer study, however, it became clear that many of the grievances complained of, and the problems disclosed, were manifestations of one fundamental and far-reaching social change, *the concentration of economic power.*"

* * * * *

"The depression has, furthermore, demonstrated that the strong and the organized are attaining an ever increasing position of dominance in our economic life; that economic power is becoming concentrated. *With this concentration old theories of economic control are proving inadequate.*"

This concentration of business accounts in large part for the lost influence of big business, and its press, and its legal lackeys, and its business organizations, in legislative and election struggles. Forty years ago big business had as its ally in every town and settlement the local merchant, local manufacturer, local banker and local utility man. Each was a leading citizen, on whom many depended for information and leadership as well as for credit and jobs. This type of man has largely gone. Why he has gone makes little difference.

In the place of this strong and leading individual is a managing clerk at the chain store who can not make a credit sale, and a local superintendent for the factory. The local bank is closed and nobody who has more authority than a bill collector represents the utility in most communities. Big business has found it to its advantage, to rotate even these men, so that no one of them is left in the community long enough to get his roots established or to really become a part of the life about him, to become a property owner or to be regarded as a fellow citizen by those among whom he dwells as a representative of an absentee control.

Thus, big business has destroyed its own defense, it has devoured its own young. The small business man who used to be our most ardent capitalist and

the most uncompromising of conservatives has been crushed, or merged, or consolidated, or otherwise retired. This has brought about a subtle change not only in economic life, but in social and political life as well. There are values in local independence and responsibility which are being sacrificed to balance sheet values.

This process seems not to be discernible to, or appreciated by the people who dominate the large industries in our great cities. It is plainly discernible to those who live in smaller cities and see the life of the community as a whole.

Revision Suggested

Can we say that our forty years of antitrust litigation, conducted by administrations which alternated between aggressive and non-aggressive policy, developing fine-spun interpretations by courts and creating uncertainty in business, has produced a satisfactory crop?

Where do we stand at the end of it? Today the government itself can not get competitive bids in basic products, the welfare of our people is dislocated by disparities between controlled and free prices, great industries in slack times hold their prices though their volume falls and their labor is idle, small business men in many lines of useful enterprise are falling like autumn leaves and the profits of commerce concentrate in fewer hands. This is a condition that I would label "Handle with care—inflammable."

In its "Platform for American Industry" the National Association of Manufacturers condemns all extensions of government control, and says:

"In opposing unsound economic and social measures it is unnecessary to propose alternatives."

If your business organizations take the defeatist attitude that there can be no remedy, or if their only contribution is opposition, they are losing an opportunity to bring practical, informed, and experienced advice to the aid of officials, most of whom would, as I do, admit their perplexity and inadequacy to the problems.

No flawless and unobjectionable plan will come from any source and no plan that I can foresee will be able to avoid an increase in governmental activity and control in our economic life.

The Attorney General has urged a revision of the Antitrust Statutes, and it would not be appropriate for me, in this stage of the matter, to put forward specific proposals which, even if advanced only as

private and personal opinions, would likely be attributed to the Department or the Administration. But it is not difficult to see the outlines of big questions that will need practical answers.

Can you identify a field where competition still may function and be protected? What changes should be made in patent laws, tariff laws, tax laws, and laws concerning federal incorporation or licensing of interstate corporations, in order to mobilize all the powers of government against monopoly? Whether we should except natural resource industries from competition, and regulate them in the interest of prudent utilization now, and conservation for the future, and whether any single formula can be applied to all industries must be considered.

Most challenging of all is the field in which the law is powerless to restore a competition which has already vanished. Shall we recognize and regulate monopoly where competition can not be revised? And if so shall we confine it to legalistic regulation, modeled on public utility regulation, that being the only regulatory legal technique we have so far developed? Or shall we use economic weapons to combat economic ills, and create a public competition where private fails, or subsidize competition when it is otherwise unable to survive?

The problem bristles with these and a thousand other questions that challenge those who would be progressive without being impractical. I urge this experienced and talented group to dedicate itself to an unimpassioned and unrestrained study of the monopoly question as it thrusts itself upon government today and of the course that may be taken to preserve the advantages of our mass production and cheap distribution without the political and economic risks and resentments which go with monopoly.

Our solution of the anti-monopoly problems must be in terms of our ideals—the ideal of political and economic democracy. We want no economic or political dictatorship imposed upon us either by the government or by big business. We want no system of detailed regulation of prices by the government nor price fixing by private interests. We do not want bureaucracy or regimentation of any kind, but we will prefer governmental to private bureaucracy and regimentation, if we have to make such a choice. We can not permit private corporations to be private governments. We must keep our economic system under the control of the people who live by and under it. In the words of the President in his second inaugural address, "We must find practical controls over blind economic forces and blindly selfish men."

What Is Expected of Our Highways?¹

By **THOS. H. MacDONALD**

Chief, U. S. Bureau of Public Roads

SUCH a simple question would appear to have an easy, almost obvious, answer. But place this question before ten individuals and it is likely there will be ten different answers. Extend the inquiry



further and the answers will continue to vary widely and to be limited only by the number of groups approached. Each of these reactions may be different, may be even antagonistic and yet be wholly sincere and logical taken singly as related to the individual or to one group. Not only is this wide variation existing now, but the greatly desired highway services of the moment are quite different than those of five or ten years ago and

much different than we must believe they will be in the future.

Is there any wonder the highway official and highway engineer ask in bewilderment, what is expected of our highways? To no group is this question quite as important as to the members of the American Association of State Highway Officials. The success or failure of each State highway department and of the Federal Bureau of Public Roads will be very largely determined by the degree to which the public's expectations of at least reasonably adequate highway service are met, regardless of limiting conditions. At the moment there is a decided trend toward criticism of highway administration and the highways that have been produced. It is a situation to be met frankly. The public are entitled to, and must have, full information upon highway policies and the indicated needs. The public must be taken into full partnership in the matters affecting the highway budget and the highway program of maintenance and construction. Not until these are accomplished

facts will the highway officials have fulfilled their responsibility or have done everything possible to secure public support. Over a long period, the progress made in each State will depend upon the confidence and support extended by the public upon the basis of information supplied by the highway departments.

When the full situation is intelligently disclosed and supported by the facts, the responsibility for providing the necessary legislation and adequate support funds rests fairly upon the State as a whole. Whatever failure there is then can not be charged against the highway officials.

The United States has been passing through a period of highway transportation development that has no parallel in any country and that can not possibly be paralleled here by a similar experience in the future.

What have we expected of our highways? In the year 1923, there were in operation 15 million motor vehicles. Now, in 1937, 14 years later, there are in operation more than 28 million—an increase of nearly 100 per cent.

In 1960, it has been competently estimated,² there will be 37 million motor vehicles in operation, which would mean an increase of 32 per cent in 23 years. But in 1923 when the number of motor vehicles was one-half that of today, the normal speed was about one-half to two-thirds the present normal speed of passenger cars. Yet it is easily remembered that the public expectation,—rather, its vociferous demand,—in 1923 upon the highway builders, was not to provide roads that in 14 years would carry two vehicles for each one, and these moving at unforeseen higher speeds, but to build surfaces with the greatest possible economy to permit stretching the dollars over the maximum mileage of main routes as yet impossible for motor traffic in wet weather. No matter how far visioned, the highway designer was dealing not with the future but with pioneer necessities. To criticize what has been done only displays ignorance of the conditions that were controlling.

What do we now expect of our highways?

Evidently the first answer is that the public expects the highways that are being built today during their reasonable life must carry an additional traffic load of 32 per cent in number of units and an addi-

¹ Presented at the twenty-third Annual Convention of the American Association of State Highway Officials, Boston, Massachusetts, September 27, 1937.

² See Charles F. Kettering—Motor Vehicles and Highways of the Future.

tional unknown per cent due to the increased per unit use. In these we find factors of change that may with some degree of certainty be provided for in highway design.

But what do we expect of our highways in other respects? Is it expected that highway transport is to be so changed as to take on the major characteristics and services of rail, air or water transportations? It is true that the fitting of each type of transportation into the national economy where each can perform its most efficient service and develop its own most useful characteristics is difficult and as yet far from completed. But the pattern is gradually emerging. In this the great utility of the motor vehicle for local transportation purposes becomes constantly more apparent. While this is not in any sense intended to be a discussion of types of transportation, so much is necessary as a background for the conclusion that to develop the highways of greatest service we must hold steadfast to the planning and building of adequate local systems in both metropolitan and rural areas. There should be no need for uncertainty if the facts available are properly evaluated. It will be most helpful to highway administrators when the public makes up its mind that highway transport is not fitted to invade the fields of mass transportation and heavy hauling over long distances which belong to rail and water transport, or to emulate the speed characteristics of air transport.

There is too much hazy thinking. There has been too much of the spirit of controversy and too little hard study and analysis of the transportation services required or desired by the public for the purpose of adjusting these to the best transportation method or combination of methods.

Future of Highway Development Depends Upon Sound Research

In the highway field new policies and new activities that are now under way give assurance that the future of highway development will more and more rest upon sound research. The list of progressive steps is impressive and at the top as the major undertaking are the State-wide planning surveys now in progress in 43 States. Many of the States are rapidly reaching the second stage of the highway planning surveys. The field surveys and the gathering of the factual data have been large scale operations and have required State-wide organization and direction. In general, these surveys have been satisfactory in the thoroughness and quality of the material gathered. While this first stage is important and neces-

sary, the second stage,—the analysis, assembly and study of the survey data,—is more important than what has been done. A vigorous attack upon the mass of accumulated data is required to bring the several kinds of factual information to understandable and usable form. This will not be accomplished easily or quickly. It will require the most intelligent effort of which each department is capable. It is the most worth while task ahead to which the commissioners and chief executives of the departments can give their best efforts and ample time. The factual data must be squeezed dry of pertinent information to be used as a foundation for a sound future highway administration program.

But from this effort intelligently and painstakingly carried to completion will emerge a true pattern of the present use, of the indicated needs, of the strength and weakness of our highways, State by State. It will be possible for the first time to bring the income and the demand for expenditures into parallel columns. Likewise it will be possible to correct legislation that is now out-moded and to formulate new legislative policies based on factual information.

Coordinate with the highway planning surveys, is the work of the Special Committee on Administrative Design Policies of this Association. While this Committee has just held its second session, this does not mean that the Committee must start at the beginning to develop design information. The policy of the Committee is to review all the previous results of research and the studies which have been made in the field to bring this all-pertinent information together and by this means to disclose the blind spots in existing information. It has immediately become apparent that many of the practices developed through research, on which we are now relying, must be discarded or materially modified as a sound basis for design practice because of the changed conditions. The major subjects will be considered in so far as possible in order of importance. For example, the first subjects are highway classification and sight distances. As rapidly as policies are formulated that are in agreement with the best information that can be secured, these design policies will be made available to the members of the Association and will become effective for the Federal aid highway development.

Grade Crossing Elimination

Unquestionably we will look back upon the substantial program of railroad-highway grade crossing elimination as one of the most advanced and produc-

tive undertakings of this period. Since the Public Works program started in 1933, there have been 3,506 new projects programmed for elimination or reconstruction of existing inadequate structures. Of this total, 66 per cent are now in service. It must be remembered that these projects are selected as nearly as possible in the order of their importance on the basis of the combined railroad and highway traffic carried. This means that we are rapidly doing away with the most important and therefore the most dangerous crossings in every State. In addition to the crossings eliminated, there have been during the same period, 2,249 projects programmed for protection.

While it is admitted that only the actual elimination of grade crossings is a solution, there are a great many crossings where the combined traffic is so small as to postpone the possibility of their elimination for an indefinite period. We must then resort to protection devices which must be at once low-cost and so designed as to give ample warning. Without being limited by the amount of highway traffic, the elimination of all grade crossings on fast through rail routes remains a major policy. This will mean that as the grade crossing program continues, we must be more discriminatory in the selection of the projects to be improved and can not continue to use, without modification, the present method of division in such a fixed ratio between the various railroads.

Soil Stabilization

In the field of soil stabilization the technique and practical application are steadily moving forward. In this development we have, for the first time, some assurance of the possibility of building really low cost roads where traffic service requirements are also in the lower ranges. It is apparent that this is a field in which a little learning may be misleading or even quite dangerous, and it is more than desirable that in each State highway department there shall be technicians fully abreast of the rapidly developing science in this subject. It is the purpose of the Bureau to continue short courses of instruction in theory and practice of soil stabilization, and these courses are open to the engineers of the State highway departments.

It is the opinion of those in the Bureau who have devoted long years to the studies, that the possibilities for better and more durable construction inherent in the application of the principles which are becoming more and more clear, have matured only in a very limited way.

While there has been a general advance in the details of design and standards of construction, attention should be called to the desirability of a more general adoption of such items as flatter slopes, raised curbs on both concrete and bituminous construction, paved gutters, the use of top soil and fertilizer on shoulders and slopes, and all other design items that will prevent soil erosion.

On a nation-wide basis the highway builders have an important part to play in furthering the national policy of soil conservation. In our national economy there is nothing more timely or that in the past has failed to receive the recognition it should have, and we must now make up for lost time and give full weight of the highway organization to the furtherance of effective soil conservation.

A critical condition is being reached in a number of States in highway affairs. This condition is the outgrowth of diversion of income, refunds of large amounts of highway user taxes collected, and bad organization. A stage has been reached, or is being rapidly approached, where the very large maintenance costs, obligations on past indebtedness, and other demands are absorbing almost the entire income, leaving no balance for reconstruction or for new construction, and of course this does not permit covering the Federal allotments with State funds. These conditions are often inherited and are not the product of those now in control, but the important consideration is the drastic revision of policies to overcome the drift toward highway bankruptcy. A considerable amount of the difficulty is chargeable to fallacies of so-called low cost construction which have now proven themselves to have been excessively high cost construction. Low cost road building is desirable where applicable to conditions, but the annual cost of our highways is the ultimate and critical cost. The cost of road maintenance should be determinative in the selection of design types in so far as possible.

The calendar year 1936 marked a high point in the mileage of highway construction completed under the joint direction of the State highway departments and the Bureau of Public Roads. Last year 19,054 miles of all types were completed which has only been exceeded slightly in one previous year,—1934.

At the present time a program of work, including the 1938 Federal aid funds, is available to the extent of \$565,000,000 which requires \$220,000,000 of State funds. A large part of this total amount available has been programmed. The work is lagging in a number of States, particularly in those States where

the highway organizations are wholly inadequate to place under way the available sums, although these are the States which need the work most seriously.

Highway Safety

Up to this point highway safety as such has not been isolated. It is established now that the safety of traffic is influenced by a large number of factors, and that all accidents are the result of a combination of these factors, each contributing in some degree. It will be recognized, then, that this whole discussion bears upon highway and street safety in so far as it is possible to remove our highways and streets from the rôle of accident factors.

It must be emphasized that the extent to which the use of streets and highways can be made safe by highway design alone is as yet purely conjectural. Accidents do not result from the careful use of highway facilities, even though inadequate; but this does not relieve the highway administrator from his responsibility to design and build and re-build highways to standards that permit the safest possible use. The highway engineer, in his great effort to serve the public, by designing meagerly and as he thought economically, is now being paid in public criticism.

Likewise, the highway administrator has been mistaken in not attaching the same degree of importance to the planting and improvement of the roadsides, as to the building of the roadways themselves. Out of really adequate highway facilities comes the safest possible use of our highways; out of the proper grading and planting of the roadsides come not only safer highways but their protection against erosion and consequent deterioration. The proper treatment of roadsides under trained and experienced direction can be made a large factor in economical maintenance. This advanced thinking in roadside treatment is demonstrated by the really marvelous improvement that the State of Massachusetts has achieved in a period of only a few years. This Association is fortunate to have the opportunity to see the transformation from ordinary highways to veritable parkways which has been brought about by the extensive program of intelligent roadside improvement, and which has been made a permanent policy of the Massachusetts Department of Public Works, applying to all future work. The State in this respect has set an enviable example, and is to be congratulated.

Also, the Association has the opportunity to inspect new highways designed in the modern manner to fit metropolitan needs. The Newburyport Turnpike

and the Boston-Worcester Highway are examples of the construction necessary to unbottle our cities. The Pulaski Highway in New Jersey, the West Side Improvement in New York City, the San Francisco Bay Bridge, the Lake Front Drive in Chicago—all accomplishments of the past very few years—in common with these new highways radiating from Boston, are examples of the type of projects which will be necessary to free our cities. The implication of cost and effort indicates the need for the adoption of very different policies for the administration of such projects.

Change in Public Policies Required

Finally, the highway engineer speaks, as to what he must have from the public if he is to serve it well. He has put into effect on an individual State basis the nation-wide planning surveys from which sound future programs can be developed; an intensive study of design practice out of which will come the necessary standards; the control of soils to insure greater durability of construction; the improvement of roadsides to provide beauty and contribute to the national soil conservation program. But there are two fundamentals which he does not have and which he cannot secure without a change in public policies: First, the rights of way necessary not only for the highway improvements themselves, but the additional land necessary to protect these improvements. Some of the arterial highways which we are building today, because of the lack of control, or divided control, or uncontrollable local control, of the roadsides, will become congested city or village streets tomorrow. The highway authorities are unable to carry out expensive construction improvements and to pay for the acquisition of high-cost land out of current revenues. These costs should be divided, and the land costs paid out of long-term bonds issued to cover such projects. There is no form of investment that would be more safe or prove a sounder one.

The second fundamental is the stabilization of our highway organizations. Under our form of government we can always expect changes at the top, but the men who constitute the going organization and who are essential to its continuity and efficiency, must be put upon a career basis by the establishment of proper Civil Service policies. It is hopeless to expect the public business of highways to be run on an efficient basis unless highway engineering is put on a professional basis with assurance of uninterrupted service as compensation for training, intelligence and devotion to duty.

Contract Awarded for Research Station for Bureau of Public Roads

A CONTRACT for the construction of buildings for the research station of the Bureau of Public Roads at Abingdon, Virginia, was awarded today to the McCloskey Company of Philadelphia by the Division of Purchase, Sales, and Traffic of the Department of Agriculture. Construction must begin within 10 days after the contract is formally made and must be completed within 18 months.

The McCloskey Company submitted the lowest bid of \$957,500 for laboratory and shop buildings, a boiler house, mechanical and electrical equipment and an alarm system. The laboratories are to be erected on a 54-acre site overlooking the Potomac River on the George Washington Memorial Highway about two miles from the Highway Bridge. Completion of the buildings and the outdoor testing facilities for work such as has been carried on at the Arlington Experiment Station will give the Bureau facilities it has desired for many years—adequately equipped and housed laboratories with considerable area for outdoor tests on a permanent location. Permanent development has not been practicable in the past at Arlington as it has been known that the land occupied would eventually be taken for other government use.

Plans for the buildings were approved by the Commission of Fine Arts with commendation of the architects' design, prior to the call for bids. The buildings are of Colonial design, in keeping with the memorial highway on which they are located. In treatment of details the architects have drawn freely from the work of architects who planned the restoration of Williamsburg, Virginia.

The left wing of the group of buildings will house bituminous investigations and subgrade soil research. The right wing will be used for structural tests, concrete investigations and other non-bituminous investigations. A two-story bay in each of these wings will be available for high testing equipment such as may be used in impact studies and in bridge tests. Air conditioning is to be provided in those rooms where control of humidity and temperature will be of importance in making tests.

The center building will be used for the machine and carpenter shops and as a garage. A small building at the right will contain the central heating plant.

In preparation for construction of buildings the Bureau has already had constructed a spur track from the adjacent R. F. & P. Railroad, a truck access road from highway U. S. 1 and water and gas mains have been laid.

Revolt Against Tax Increase Revealed as 160,000 Persons Sign Formal Plea in Missouri

A SIGNIFICANT revolt against increased taxation has taken form in Missouri. Citizens of that state have placed their signatures in overwhelming number upon a petition which demands that a law increasing the state gasoline tax, recently passed by the legislature, be referred to a vote of the people at the general election in November, 1938.

Incomplete compilations show 160,000 persons have signed the petition during a 30-day period. A total of 65,000 signatures, representing five per cent of the number of legal voters in two-thirds of the state's congressional districts, would have been sufficient to effect a popular review of the legislature's action.

This decisive protest against a tax increase has an interesting background.

In 1928, the people of Missouri adopted a constitutional amendment providing for a state highway bond issue of \$75,000,000 and specifying that money raised by state motor vehicle registration fees and gasoline taxes be used only for state highway purposes. The amendment also provided that the legislature could not increase the registration fees or gasoline taxes within a ten-year period.

A two-cent gasoline tax, imposed by a vote of the people in 1924, was then in force.

Governor Lloyd C. Stark recommended to the 1937 session of the legislature that the tax be increased to three cents a gallon, effective at expiration of the ten-year period in November, 1938.

The Automobile Club of Missouri, for many years a dominant influence in legislation dealing with highways and taxation of motorists, vigorously opposed the proposed increase. In earlier years, the club had initiated or sponsored most of the legislation under which more than \$300,000,000 has been expended on Missouri's highway system, producing 15,000 miles of improved roads.

The club's officers and board of governors took the position that all new highway and motor-tax legislation should await completion of the state's highway planning survey and development of a long-

range and rational highway program on the basis of that survey. This position was supported by 97 per cent of those voting in a poll of the club's 25,000 members.

The Governor insisted upon enactment of the tax-increasing measure and it was passed by the legislature and signed by him.

Proceeding along lines made possible by the state constitution that provides for popular review of legislative action, the Automobile Club of Missouri and the Missouri Petroleum Industries Committee then undertook circulation of petitions to refer the law to a vote of the people at next year's general election—*Highway Highlights*.

Federal Roads Bureau Reports on Work Completed Last Year

MORE than 22,000 miles of highway of all classes were completed under the supervision of the Bureau of Public Roads in the fiscal year that ended June 30. By far the greater portion of this work was done in cooperation with State highway departments and under detailed State supervision. In this class were 11,401 miles of road financed in large part with special emergency funds and 7,367 miles of regular Federal-aid work.

Notable progress was made in the Federal program of elimination of hazards at grade crossings in which 1,149 crossings were eliminated, 574 were protected with signals or other devices and 196 grade separation structures were reconstructed. The Federal bureau points out that this work is important because it includes many of the most dangerous crossings on heavily traveled routes that have heretofore been neglected because of the large cost.

Payments of Federal funds to the States on account of the above work totaled \$337,747,071. At the close of the fiscal year the emergency funds were very largely expended and future work will be supported by annual authorizations for each of the fiscal years 1938 and 1939 of \$125,000,000 of Federal aid for improvement of the Federal-aid system, \$25,000,000 for secondary roads and \$50,000,000 for elimination of hazards at grade crossings.

Other work completed under bureau supervision included 139 miles of highway in national forests, 169 miles in national parks, 245 miles in public lands, and 33 miles of replacement of flood damaged roads. Nearly 3,400 miles of road built with funds provided

by other Federal agencies and turned over to the bureau for supervision of construction were completed.

Highway planning surveys are being carried on by 44 State highway departments in cooperation with the Federal government. Field work in collecting data on road mileage and conditions, on the volume of traffic on highways and on highway finance has been completed in most States. States that have completed the field work are now tabulating a mass of data that have been collected and when this is completed there will be available a complete picture of the highway situation. Information on the relative importance of each section of highway, sources of highway revenue and purpose for which spent, the extent to which rural and urban residents contribute to the cost of each class of road, and the benefit they derive by travel upon each class will all be used in planning future highway work.

Work on the Inter-American Highway from the United States to Panama has continued at increased speed during the past year. Impassable gaps have been reduced to 560 miles and these should be closed rapidly when bridge construction now under way is completed. Under cooperative agreements with three of the Central American Republics, materials, machinery and technical direction are being supplied by the United States for the construction of nine bridges and labor and local materials are being supplied by the countries concerned. Engineers of the Bureau of Public Roads are supervising the location and building of sections of the route in Costa Rica, Nicaragua, and Guatemala.

Investigations of road materials and methods of construction have been continued by the Federal roads bureau. Important facts have been learned concerning the required dimensions and reinforcement of concrete roads, the design of slabs for bridge floors, and the properties of bituminous materials.

A problem that many investigators have attempted to solve with little success is being attacked by the research engineers of the bureau. This problem is to work out a method of designing flexible type road surfaces such as gravel, macadam and bituminous mixtures applying principles of mechanics and mathematics. Such a method is needed to design surfaces properly for different loads, taking into account differences in materials and in soils on which road surfaces are placed. Special apparatus is being devised for use in tests that are to be made to throw light on the subject.

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